OUR BOOKSHELF.

Miners' Nystagmus: its Causes and Prevention. By Dr. T. Lister Llewellyn. With a preface by Prof. J. S. Haldane, F.R.S., and a legal appendix by Douglas Knocker. Pp. xix + 158 + plates. (London: *The Colliery Guardian* Co., Ltd., 1912.)

Miners' nystagmus is a disease which incapacitates a large number of coalminers, and is estimated by Dr. Lister Llewellyn to cost the country 100,000*l*. a year. It is characterised by rapid involuntary movements of the eyes, associated with defect of vision, photophobia, and night-blindness. Many theories have been brought forward to account for the disease. Of these the myopathic theory has been most supported in England, chiefly owing to the writings of the late Mr. Simeon Snell, of Sheffield. The work is carried on in constrained positions, often necessitating prolonged exercise of the extra-ocular muscles in an abnormal manner. It is now generally admitted that undue weight was attached to this factor, and attention has been specially directed to the view that the real cause is the poor illumination, a suggestion first made by Romiée, who, however, thought that excessive accommodation was an essential concomitant.

Dr. Llewellyn, as a former medical officer to a South Wales coal and iron company and as Tyndall Research Mining Student of the Royal Society, has had excellent opportunities for investigating the disease. He has used his opportunities to the full, and his work is a model of what such a research should be. He has shown conclusively that miners' nystagmus is practically limited to coal mines in which safety lamps are used, those in which naked candles are employed being exempt except for cases which have been transferred from safety-lamp mines. He has made exhaustive inquiries into the conditions of work and the illumination at the coal face. The estimations of illumination appear to have been made with great care and accuracy, and the same may be said of the clinical investigations. In addition to his own researches, his book contains an admirable *résumé* of the opinions and work of previous writers on the subject. The criticisms are judicial in tone, and the exposition of his own views allows the facts and arguments to carry conviction without undue stress. The work is of interest not only to those specially associated with the mining industry, but also to the physician and physiologist. We consider that Dr. Llewellyn has accomplished a difficult task with distinguished success.

Catalogue of the Lepidoptera Phalaenae in the British Museum. Vol. xii.: Catalogue of the Noctuidæ in the Collection of the British Museum. By Sir George F. Hampson, Bart. Pp. xiii + 626. (London: Printed by Order of the Trustees, 1913.) Price 17*s*. 6*d*.

The subject of this volume of the "Catalogue of Moths" is the classification of part of the Noctuid subfamily Catocalinæ. The remaining portion of the subfamily, together with the small subfamilies Mominæ and Phytomatrinæ, will appear in vol. xiii. The Catocalinæ are represented in the present volume by sixty-three genera and 643 species, and are characterised as follows:—Vein 5 of the hind wing is developed fully and arises close to the lower angle of the cell; the eyes are smooth and not overhung by "cilia"; the mid tibiæ are always spined, and the fore and hind tibiæ may also be armed similarly. The subfamily is a modification of the Quadrifid section of the Noctuidæ; it is distributed fairly evenly in the temperate and tropical zones, but has few arctic or alpine forms.

Volcanoes: Their Structure and Significance. By T. G. Bonney. Third edition. Pp. 379. (London: John Murray, 1912.) Price 6*s*. net.

Prof. Bonney's well-known volume was reviewed at length in the issue of Nature for May 11, 1899 (vol. lx., p. 27), at the time of its first publication. Many minor alterations have been made in the present edition, and several paragraphs inserted dealing with volcanic eruptions which have take place recently. The chapter on the theories of volcanoes has been considerably modified so as to incorporate the results of research accomplished during the last fourteen years. Some new illustrations also have been added.

LETTERS TO THE EDITOR.

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The Radio-elements and the Periodic Law.

At a meeting of the Royal Society on February 27th, Mr. F. Soddy made a verbal communication which was published under the above title in the *Chemical News* of the following day. The importance of the conclusions which are drawn justifies an examination of the evidence on which they rest. I do not approach the question unsympathetically, and I am quite willing to take some risks, but, when asked to accept a theory, I like to draw a distinction between a guess, a reasonable generalisation, and a well-established conclusion. If Mr. Soddy only wishes to put forward a theory which is not inconsistent with the facts so far as they are known at present, I have nothing to say, but if he claims anything approaching to experimental proof, some critical comment may be forgiven.

Mr. Soddy believes in the existence of a number of bodies which differ in molecular weight but "are non-separable by any known process"; these are also supposed to have identical spectra. Among "known processes" I count gravitation, diffusion, and mechanical processes, such as separation by centrifugal forces, among which diffusion, perhaps, is the only available one. Is there any reason to suppose that molecules which, ex hypothesi, differ in mass, cannot be separated by diffusion? Some of the bodies concerned are gaseous, others no doubt are volatisable, and though diffusion may not act very effectively, owing to the close approximation of the densities, the presumption is that the molecules, having different masses, travel with different speeds, and that it is

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therefore incorrect to call two gases with different densities "non-separable by any known process."

Electrical and magnetic forces are also agents which can be applied to distinguish between molecules having different masses. Such forces should be considered before any sweeping assertions are made.

It is possible that Mr. Soddy wishes his statement to be limited to the ordinary chemical processes, and as he is trying to prove a negative, it is perhaps unfair to be too critical, but one cannot help remembering the time when neodym and praesodym were "non-separable," and reflecting how many substances might not be separated at the present moment if their optical properties had not given us a clue. No doubt radio-active tests are severe, and the chemical properties of the bodies in question are probably more nearly equal than those of the older chemistry, but there is a vast interval between "very similar" and "identical."

Incidentally, we may reflect that these bodies which are believed to be "non-separable" actually separate themselves of their own free accord in the natural course of their subsequent history, but this may only prove the perversity of nature.

According to Mr. Soddy's theory, the non-separable bodies have identical spectra. This is the vital issue, which, if made good by experiment, will help us to overlook many weaknesses in the argument. The evidence here rests entirely on one experimental fact. It was shown by Russell and Rossi, and also by Exner and Haschek, that a mixture of ionium and thorium does not show in the electric arc lines which can be assigned to ionium, the spectrum of the mixture being identical with that of pure thorium. Assuming that ionium is the only intermediate product between thorium-II. and radium, the life of ionium is 100,000 years, and the ionium-thorium preparation of Russell and Rossi must have contained about 16 per cent. of ionium. But these authors also point out that if the length of life is reduced to 12,000 years, the preparation would only contain 2 per cent., and the absence of ionium lines would be accounted for. At present the radio-active evidence seems in favour of the longer period, and the absence of ionium lines wants explaining; nevertheless, it seems to me to be going ahead too quickly to make a sweeping assertion that not only is the spectrum of ionium identical with that of thorium, but that the same holds in all similar cases, for the accumulated evidence of the spectra of known bodies has all been in the direction of indicating that optical properties of absorption and radiation discriminate in the most decisive manner between bodies which are otherwise similar in chemical properties.

Granting now for the sake of argument that the bodies in question have spectra which cannot be distinguished from each other, it remains to examine the alternative that the bodies are actually identical. It is said that they have different molecular weights, because one has been formed from the other by an expulsion of one α and two β particles. This argument is not necessarily conclusive, as a mass equal to that expelled may have been picked up again in the process. It may be urged that the subsequent history of these bodies shows that they are essentially different. Though a strong argument, this is not quite the last word, because, granting for a moment the temporary identity of two systems, the particular instability which determines their future may depend on their past.

Taking all arguments into consideration, we are left with an interesting theory consistent with our present knowledge but supported by very little real evidence. It may be presumptuous for one who can only claim to be an amateur in modern physics to express an opinion, but having in a previous generation taken part in establishing the fact that the same element can have different spectra according to its molecular constitution, one cannot, without good cause, accept the belief that different elements can have the same spectrum. Mr. Soddy's case would be much strengthened if he could adduce positive instead of merely negative evidence, and this might be supplied if the bodies grouped together with thallium lines could be shown to give the thallium spectrum, assuming thallium not to be present in the raw material.

ARTHUR SCHUSTER.

Manchester, March 7.

Atmospheric Electrification during South African Dust Storms.

THIS short note on the variation in the atmospheric electrical charge due to the presence of dust is not intended to be exhaustive, but merely to direct attention to a factor which has a very great influence in modifying the positive potential gradient existing in the atmosphere during fine weather. Very few observations as to the causes of the variations have been recorded, but Prof. Michie Smith seems to have observed (*Phil. Mag.*, vol. xx., p. 456) something of the same kind during dust storms in India. He notes that "the negative electrification was strongest during gusts of dust-laden air," and, further, "the potential would often run up so rapidly that it was impossible to measure it accurately, whilst during lulls it would often fall almost to zero."

I was, however, unaware of any work having been done in this direction until the present year, though I have been making a study of the variations in the potential gradient over the high veld in South Africa, and have published several short papers on the subject.[1] The general result has been to show that very extraordinary variations are caused by the presence of dust in the atmosphere, whether due to the natural dust-storms or to any artificial means, such as the clouds of dust raised from the mine refuse heaps formed during the working of the cyanide process. At all the places where observations have been taken the dust is either sand or is of siliceous character, and invariably has the effect of lowering the positive potential gradient, and if present in sufficient quantity, to reverse it and give a very high negative gradient.

During the past six months systematic observations have been taken at Bloemfontein with a Bendorf recording electrometer, furnished with a radium-coated plate to act as collector. (The apparatus was obtained by aid of a grant from the Royal Society of South Africa.) The normal potential gradient in South Africa is, of course, positive, but varies considerably with the elevation. The diurnal range is also considerable under fine weather conditions, and during stormy weather very great deviations are shown if rain is falling or dust is blowing. It may be noted here that during the past eighteen months, when very little rain has fallen, the charge brought down by the rain has been invariably negative. A study of the records made by the electrometer shows that three types have to be considered, viz. :—(1) The ordinary fine weather record; (2) record taken on a day when some dust is blowing; (3) record taken on a very dusty day.

In the first case, the positive gradient rises to a maximum at about 7 to 8 a.m., falls to a minimum at midday, remains fairly uniform over a period of several hours, and then rises to another maximum. The slope of the curve is steeper for this second maximum than for the first one. Fig. 1 shows such a curve which was taken in July, from midnight to midnight. The horizontal line shows zero potential,

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[1] *South African Journal of Science*; Proc. Roy. Soc. South Africa.

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